FINAL REPORT FOR NASA-JSC ORDER T-1213A

"Radioactive Halos and Ion Microprobe Measurement of Pb Isotope Ratios"

One purpose of the investigation was to obtain, if possible, the Pb isotope ratios of both lunar and meteoritic troilite grains by utilizing ion-microprobe techniques. Such direct in situ measurement of Pb isotope ratios would eliminate contamination problems inherent in wet chemistry separation procedures, and hence conceivably determine whether lunar troilite grains were of meteoritic origin (i.e. through a similarity of Pb isotope ratios).

For comparison purposes two samples of meteoritic troilite were selected (one from Canyon Diablo) for analysis along with two very small lunar troilite grains (≈50-100μm). The latter were obtained from Dr. H. T. Evans, USGS, Washington, D.C. and were from parent samples 10047 and 10012.

The accompanying table shows the results of the variation in the $^{206}Pb/^{204}Pb$ ratio as the ion-microprobe beam sputtered into the troilite. These results were obtained using a O_{16}^- and NO_2^- primary beam on the ion microprobe at McCrone Associates in Chicago.

These results left something to be desired because secondary ion signals were very low. Therefore, additional Pb isotope measurements were made on the same samples with the ion microprobe at Oak Ridge utilizing a positive primary beam (O_{16}^+). In this case severe charging problems were encountered (because the troilite matrix is a non-conductor) and the secondary ion signals were too erratic to permit calculation of accurate isotope ratios. It is concluded therefore that the ion microprobe as presently operating, does not permit the in situ measurement of Pb isotope ratios in lunar or meteoritic troilite. On the basis of these experiments no conclusions can be drawn as to the origin of the lunar troilite grains.

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TABLE 1

Pb_{206}/Pb_{204} Ratios

Sample Designation	Maximum ratio at surface	Maximum ratio in interior	Minimum ratio in interior
Large Lunar Troilite	16.0	15.2	10.9-11.0
Small Lunar Troilite	17.3	15.8	11.8
Canyon Diablo Troilite	16.6	15.4	10.7
1721M Troilite	17.1	15.9	11.5

TABLE 2

Pb_{206}/Pb_{204} Ratios in Depth

Depth, Å	Large Lunar Troilite	Canyon Diablo Troilite
1000	15.7	16.0
1500	15.4	15.8
2000	15.3	15.7
2500	15.0	15.4
3000	14.7	14.7
3500	14.5	13.9
4000	12.3	11.8
4500	11.1	10.9
5000	14.5	10.7
5500	14.8	13.5
6000	13.5	13.1
6500	13.7	13.6
7000	13.6	12.9
7500	11.1	12.1
8000	11.0	13.8
8500	13.5	13.9
9000	13.8	14.0